NEWS Science Team Meeting Report
December 2-3, 2009

Overview of NEWS Historical Perspective and Organization

In 2003 NASA established the NASA Energy and Water-cycle Study (NEWS), whose long-term grand challenge is to document and enable improved, observationally based, predictions of water and energy cycle consequences of Earth system variability and change. However, recognizing that the broad objectives of energy and water cycling related climate research extend well beyond the purview of any single agency or program, and call for the support of many activities that are matched to each agency's respective roles and missions. Therefore, to achieve the ultimate goal of credible global change predictions and applications across all significant scales, NASA continues to seek collaborations with other Federal and international agencies, the scientific community-at-large and private industry.

Since the November 2008 NEWS meeting, the project has been working on how to refine NEWS' team approach to tackling integration. In response to comments voiced at the meeting, NEWS is attempting to create a structure that allows for consistency from existing NEWS activities, (aka conservation of scientific momentum), and at the same time welcomes the new NEWS PIs and their projects. To these ends, the project proposed creating four co-chair-led NEWS working groups that build off all the projects and the previous NEWS question-based groups. The principle objective of the 2009 Science Team meeting was to become aware of project accomplishments, identify the integration needs and make the needed connections within four main working groups; Drought & Flood Extremes, Evaporation & Latent Heating, Water and Energy Cycle Climatology and Modeling & Water Cycle Prediction. Two co-chairs for each working group have been selected to lead these efforts. To be successful, the NEWS team must partner and coordinate with water & energy cycle research and application activities going on at other organizations within NASA, nationally, and internationally.

The four groups established in 2009 are:

- ***Drought & Flood Extremes***- including water and energy aspects of abrupt climate change (Co-Chairs: Dong, Albertson)
- ***Evaporation & Latent Heating*** - including both land and ocean (Co-Chairs: Hilburn, Famiglietti)
- ***Water and Energy Cycle Climatology*** - to exploit and influence evolving observing systems (Co-Chairs: Rodell, L'Ecuyer)
- ***Modeling & Water Cycle Prediction*** - foster interaction with the global modeling community (Co-Chairs: Bosilovich, Hu)

The principal goal of the working groups will be to propose and implement the development of scientific papers that integrate various NEWS research within the working group topic. The working groups are expected to:

- Coordinate and integrate NEWS PI science investigations
- Liaison with relevant flight missions and NASA R&A Programs
- Implement annual assessment of progress in meeting NEWS scientific requirements
- Contribute to periodic Implementation Plan (IP) updates

In addition the working groups are encouraged to:

- Promote/lead integrated scientific journal publications
- Prepare annual progress summaries
- Conduct regularly scheduled telecons

The working groups are also encouraged to assist in planning and organization of annual Science Team meetings and sessions at national meetings (e.g. AMS, AGU) In support of these working groups, the project planned the annual NEWS meeting around the working groups, with significant science discussion breakouts.

New Project Approach and Structure

Since initiation of the project by NASA and publication of the Science Implementation Plan in 2007, NEWS has focused on addressing the range of Phase 1 objectives with oversight provided by the NEWS Science Integration Team (NSIT). While reasonably successful, the NSIT strategy did not adequately achieve the key objective of integration across the individual PI led investigations. In early 2009 a decision was made to realign the project into the four working groups noted previously, each led by a chair and co-chair, initially appointed by NASA, but subject to change as may be appropriate. The primary responsibilities of the new working groups are to enhance the coordination and integration of the individual investigations across NEWS and to identify opportunities for exploiting relevant research outside NASA. The December meeting provided the first opportunity to test this strategy under which the working group co-chairs provided the necessary leadership.

Summary Working Group Reports

Following a short plenary session, the meeting adjourned to individual working group sessions to address the essential objectives of the meeting including the following questions, to be reported at the day-2 plenary session

- What does the panel hope to achieve and on what time-scale?
- What key research topics will the panel members address?
- What informal mechanisms for facilitating coordination will be adopted? (are there specific assignments?)
- What are panel plans for liaison with relevant flight missions and other NASA R&A sponsored research? (other agency connections?)
- What potential scientific journal publications are envisioned?
- What are the co-chair plans for regularly scheduled telecons?

The following summary reports were submitted by the working group chairs following the December meeting.

Drought & Flood Extremes Working Group (Co-Chairs Xiquan Dong and John Albertson)

The objectives of the Drought and Flood Extremes working group are to understand the mechanisms responsible for regional water and energy extremes, to investigate their relationships with continental and global scale processes, and to assess their predictability and feedbacks in the context of bridging climate and weather scale. This group places a high priority on enhancing, reconciling, and sharing novel datasets to diagnose the above issues.

The group's progress to date includes a successful integration example and more than ten presentations given in the Extremes breakout session during the NASA NEWS meeting on December 2009. At the end of the meeting, the group outlined four integration papers with collaboration between PIs within the Extremes working group and other working groups. The Extremes working group will investigate the two golden years using both model and observations and the linkage between local extremes with continental and global scale processes.

Over the next five years, potential goals include: investigating how the regional extreme events link with continental and global scale processes, how to assess the predictability and feedbacks of these regional extreme events, the minimum Arctic ice extent during Summer and its seasonal variation, and Drought persistence over California.

The Drought and Flood Extremes working group will continue to use Google groups (http://www.nasa-news.org/integration/) to share documents and presentations, and plan to have a working group telecon once a month. An Extremes working group meeting during the summer of 2010 is also being considered.

Evaporation & Latent Heating Working Group (Co-Chairs: Kyle Hilburn and Jay Famiglietti)

The mission of the Evaporation and Latent Heating Working Group is to understand the role of latent heat fluxes in the climate system, including energy transports and their role in weather phenomena. Accomplishing this mission requires the "best" latent heating flux data for a range of scales and applications, including global water and energy balance down to the smaller space-time scales of individual extreme events. The working group is focusing on satellite era datasets from 1988 to the present.

The goal of the Evaporation and Latent Heating Working Group is to provide integrated latent heating products that can be used for benchmarking and for answering other working group and NEWS synthesis questions. The first step towards accomplishing this goal is to understand and characterize the variability and uncertainties within land and ocean latent heating datasets and characterize the variability between datasets. This will include regional assessments and will involve collaboration with other working groups (Water and Energy Cycle Climatology, Modeling and Water Cycle Prediction) towards improved global products. This working group also seeks to identify best practices for dataset construction and comparison.

The working group's progress to date includes definition of the members of the group, articulation of the working group mission, and decision about the most important goals for the working group. So far, the collaboration strategy for the group has involved use of email, telecons, and Google Groups. The Water and Energy Cycle Climatology Group provides a good template for collaboration strategy.

The working group hopes to achieve all of its goals over the next five years. The primary obstacles to accomplishing our goals are manpower and leadership. More time will be needed for group discussion to allow the ideas behind our goals to mature.

The members of the working group made a number of suggestions for new and future initiatives, including: building an observational database from existing ocean and land data sources, beginning an assessment of NEWS and other latent heating products, performing regional water budget studies over land and ocean, analysis of latent heat fluxes in extreme events such as hurricanes, study of energy transports, and the use of isotopic studies to constrain latent heat flux estimates.

The working group agreed that a valuable publication would result from a global analysis of latent heating flux products to converge on a NEWS recommendation or benchmark, or at least a median/mean with a spread. This analysis would need to make some measure of uncertainty, and regional comparisons to observations would be used.

Water and Energy Cycle Climatology Working Group (Co-Chairs: Rodell, L'Ecuyer)

The goal of the NEWS Water and Energy Cycle Climatology group is to harness the expertise in the NEWS team to develop "state of the global water cycle" and "state of the global energy cycle" assessments based on recent, high quality ground and space based observations and data integrating models. We have begun by attempting to estimate the mean fluxes of the water and energy cycles at continental and ocean basin scales, as well as the global scale. It was noted that despite being "global", many of the datasets we propose to use will have some gaps in very challenging regions (e.g. evapo-transpiration over coasts and satellite products in polar regions). Some thought will need to be given into the importance of these gaps and how best to merge model-based estimates to fill in these gaps if necessary. To that end we have generated spreadsheets that encapsulate multiple estimates of each flux over each continent or basin, and associated error estimates. We intend to submit two parallel papers on our results, one for the water cycle and one for the energy cycle, by the end of 2010.

The group's primary topic of discussion at the NEWS team meeting was what needed to be done to complete the initial study and write the first two papers. First, there are gaps in the current spreadsheets that must be filled, and estimates that must be improved. Eric Wood committed to providing satellite based estimates of evapotranspiration to complement the GLDAS and MERRA model estimates currently in the spreadsheets. Dennis Lettenmaier's group will produce a new global runoff dataset similar to the one currently used for the spreadsheet that was developed by Aiguo Dai (who attended the meeting) and Kevin Trenberth. Lettenmaier's new runoff dataset will be produced in a fashion similar to the Dai and Trenberth dataset, but it will use the VIC model rather than CLM, and it will address certain issues such as D&T's lack of data after 2006. Runoff estimates for Australia and the Oceanic islands will be improved using model output and additional estimates from Fekete and Vorosmarty. Tim Liu agreed to provide atmospheric convergence estimates for Africa, Australia, and possibly Eurasia. MERRA based convergence estimates will also be used. Carol Anne Clayson's new SeaFlux estimates will be incorporated into the spreadsheet.

Next, multiple estimates of the same flux must be merged. It was agreed that the estimates would be weighted and combined using their associated uncertainty information. There was much debate over whether to force the water (or energy) budgets to balance over each region and use that as an additional constraint to refine the flux estimates. In the end, it was decided that both the initial flux estimates and those that resulted from forcing the water budget to balance would be included in the water cycle paper. However, energy balance should not be forced because of the possibility that there is a real and significant residual. How this discontinuity between the two parallel studies would be addressed in the papers was not resolved. A comment was raised at one point that by doing basin-scale energy we are almost obligated to also estimate transports between basins in these first two papers. This comes back to the issue of the scope of these initial papers and will need to be discussed further when we are ready to write up the results.

The outline of the papers was developed, including which elements of water and energy cycle climatology research to include in the first two papers and which to save for future papers. It was determined that the current study would be expanded to include monthly seasonal cycles. Priorities were set for follow on studies, including (1) assessing interannual variability and trends at the same scale, (2) moving to smaller scales, such

as river basins or climate regimes, and (3) refining the flux and error estimates in the current continental-scale study.

The water and energy cycle climatology working group will reconvene in the new year with biweekly teleconferences. The Google group website will continue to be the primary mechanism for sharing files and data.

Modeling & Water Cycle Prediction Working Group (Co-Chairs: Bosilovich, Hu)

1. Objective

The objective of the Modeling working group was to gather information from the PIs working on model related projects and also to develop connections with the observations and process related projects. In general, many of the projects in NEWS have some interest or need for model data or experiments. This interest clearly shows a role for model connections within NEWS and reaching out to MAP. At the same time, projects are funded on their own merit with their own deliverables, and finding the intersections of projects without incurring significant additional effort is a challenge. Nonetheless, a lot of new information was presented to the group and some ideas were suggested for integrative projects.

2. Overview Discussions

PIs who signed up for the modeling working group were invited to present at the meeting. The presentations are available from the NEWS www site:

- MERRA Preliminary Analysis: Water and Energy Budgets, Evaporation and Extreme Events – Bosilovich
- Climate Variability and the Tropical Oceans During the Satellite Era: Integrating Observations and Reanalyses - Robertson
- Examining the relationships between precipitation and surface temperature by means of MERRA and GPCP products – Gu
- Goddard Multi-Scale Modeling System with Unified Physics– Tao
- A perturbed physics ensemble climate modeling study for defining satellite measurement req. of energy and water cycle – Y. Hu

Modeling Components of LandFlux – Peters-Lidard/Mocko

3. Validation Metrics and Diagnostics

An outcome of the discussions was that an intersection of the observational groups and model groups was the formulation of validation metrics and diagnostics, specifically targeted as NEWS high-priority topics. For example, while reanalyses, such as MERRA can provide a bridge between models and observations through continuous fields of data and many ancillary variables that are not observed, it still has limitations (some bias and artificial trends). There is still much to be done on characterizing MERRA regional water and energy budgets, and the new NEWS data should play a significant role there. It is critical to work with the observations groups to best characterize the uncertainty in the observations as well as the models/reanalyses.

Even though analyses/reanalyses assimilate observations, the resulting processed data may still uncertainty. This is easily seen by comparing many reanalyses physical processes fields (e.g. precipitation or TOA outgoing longwave radiation). For example, high latitude, and even some tropical regions have limited numbers of observing sites, and in these places reanalyses can rely more on model predictions than observations. However, defining this uncertainty and where the reanalyses have similar errors will define the work that needs to be done to generally improve models and hence, predictions. With more than a half dozen global reanalyses available for

comparison, reasonable estimates of the uncertainty of reanalyses can be quantified.

4. Landflux

The modeling of land surface processes, especially fluxes, was discussed at length. Specifically, NEWS related flux projects (model and observation) should have a role in the development of the international Landflux initiative. While some observation-related projects have made connections, NEWS modeling efforts still need to have a more organized approach. New offline land flux model products with MERRA atmospheric forcing (using both surface data and lowest atmospheric model level data) are expected, as well as with the EU Watch atmospheric forcing (which is already in use by several other groups for LandFlux). These two forcing data sets will allow the examination of the influences of the forcing dataset and of the height of the surface forcing on the fluxes. The MERRA-forced products will be extended to 2009, which will take advantage of data from EOS and other modern satellite platforms. NEWS could contribute a validation plan for Landflux efforts, including parameter data sets, atmospheric forcing input, and flux output. Further, integrated output would also make for a strong validation methodology (for example, river discharge data could be compared to model river output).

5. Integrative Projects

Several integrative projects, near and longer term, have been suggested, but would still be in the formative stages. Near term projects have the potential to start and produce soon, but longer term projects may be significantly different than any currently funded projects. These are:

- Water vapor transport and climate variability (near)
- A NEWS contribution to LandFlux (near)
- GCE forced by MERRA, better explanation of MERRA clouds compared to field experiments (near)
- Metrics/Diagnostics for model evaluations of quality of water and energy budget data (long)
- MERRA Replay experiments (e.g. ocean surface evaporation parameterization) (long)
- Ensemble of reanalyses to quantify uncertainties of reanalyses fluxes (long)

Furthermore, it may be possible for the GMAO to help with additional numerical experiments that are contribute to NEWS modeling efforts and can feedback to GMAO systems.

6. Further progress and communications

Holding model only telecons may not be the best way forward, as the topic may seem exclusive to the NEWS PIs that the model group wants to collaborate with. Also, the topics on such a call may not all be of interest to a wide range of investigators. So, one possible way forward is to hold more topical, process-oriented telecons for the actively developing projects.

Some Examples of Recent NEWS-Driven Publications

Zaitchik, B.F., M. Rodell, and F. Olivera (2010), Evaluation of the Global Land Data Assimilation System using Global River Discharge Data and a Source to Sink Routing Scheme, *Water Resour. Res*., doi:10.1029/2009WR007811, in press.

Ozdogan, M., M. Rodell, H.K. Beaudoing, and D. Toll (2010), Simulating the Effects of Irrigation over the U.S. in a Land Surface Model Based on Satellite Derived Agricultural Data, *J. Hydrometeor*., doi: 10.1175/2009JHM1116.1, in press.

Zaitchik, B.F., and M. Rodell (2009), Forward-looking Assimilation of MODIS-derived Snow Covered Area into a Land Surface Model, *J. Hydrometeor*., 10 (1), 130-148

Syed, T.H., J.S. Famiglietti, M. Rodell, J.L. Chen, and C.R. Wilson (2008), Analysis of Terrestrial Water Storage Changes from GRACE and GLDAS, *Water Resour. Res*., 44, W02433, doi:10.1029/2006WR005779.

Dong, X., B. Xi, K. Crosby, C.N. Long, and R. Stone (2010), A 10-yr Climatology of Arctic Cloud Properties and Surface Radiation Budget Derived from Ground-based Observations at the ARM NSA site and NOAA Barrow Observatory. *J. Geophys. Res*., in press.

Xi, B. and X. Dong, P.Minnis, M. M. Khaiyer, (2010), A 10-year Climatology of Cloud Cover and Vertical Distribution Derived from both Surface and GOES Observations over the DOE ARM SGP Site. *J. Geophys. Res.* in press.

Kennedy, A, X. Dong, B. Xi, P. Minnis, A. Del Genio, A. Wolf and M. Khaiver (2010), Evaluation of the NASA GISS Single Column Model Simulated Clouds using Combined Surface and Satellite Observations. Accepted by *J. Clim.,* in press.

Open Issues

- Working Group restructuring (recognizing the role of modeling)

  (In response to concerns raised by a number of NEWS investigators subsequent to the December meeting, consideration will be given to further streamlining the working group structure. In particular, the extensive role of modeling throughout the spectrum of NEWS research activities suggests that a separate modeling working group may not necessary, rather that modeling be an integral component of the three primary working groups. This will require further discussion prior to a decision.)

- Project management and Working Group leadership arrangements (post NSIT)

- Research priorities for future proposal solicitations

- Opportunities for expanded interagency/international coordination

- Participation in future NASA hydro-meteorological relevant flight missions

- Assessment of progress in meeting NEWS IP Phase-1 objectives

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